

Iberdrola Renewables

Forecasting Methodology in BPA's BA



Elk River Wind Power Project, Kansas

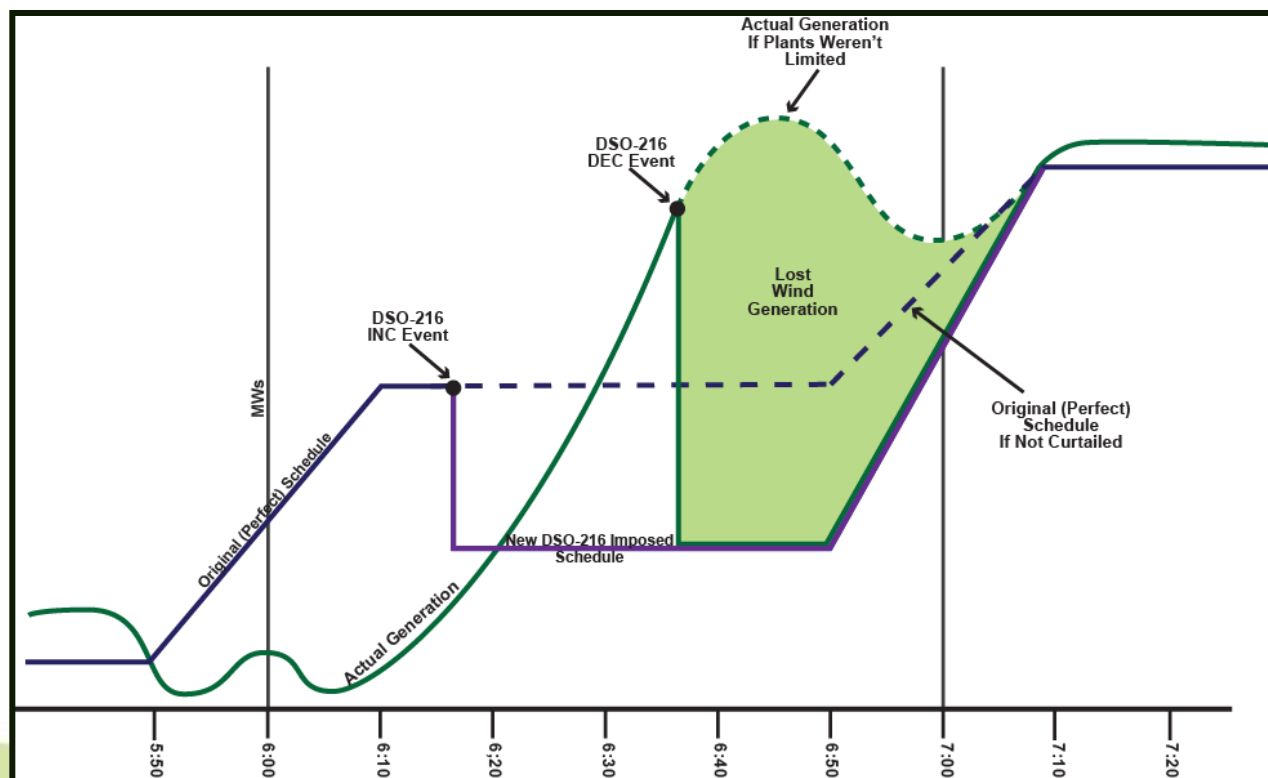
Background



- Iberdrola Renewables is committed to producing the best possible wind forecasts and scheduling its wind facilities on BPA's system as accurately as possible
- With the implementation of Persistent Deviation (PD) penalties and Phase II of DSO-216, Iberdrola Renewables had an understanding of BPA's preferences and expectations with regard to forecasting choices
 - An inherent conflict exists between DSO-216 and PD under certain wind conditions forcing a forecaster to choose between incurring a PD penalty or submitting a suboptimal schedule that may contribute to a DSO-216 event
 - Iberdrola Renewables understood the avoidance of DSO-216 events to be BPA's first priority and was submitting schedules designed to mitigate exposure to DSO-216 events during anticipated wind ramping episodes
 - BPA states that both the number and magnitude (MWh affected) of DSO216 events has been less than expected. Iberdrola Renewables believes our scheduling practices have contributed significantly to this fact.
 - Iberdrola Renewables' efforts to avoid DSO-216 events resulted in numerous PD penalties of approximately \$1 million

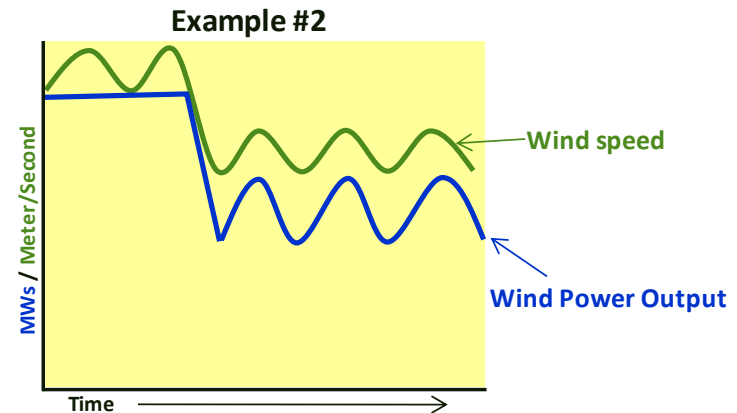
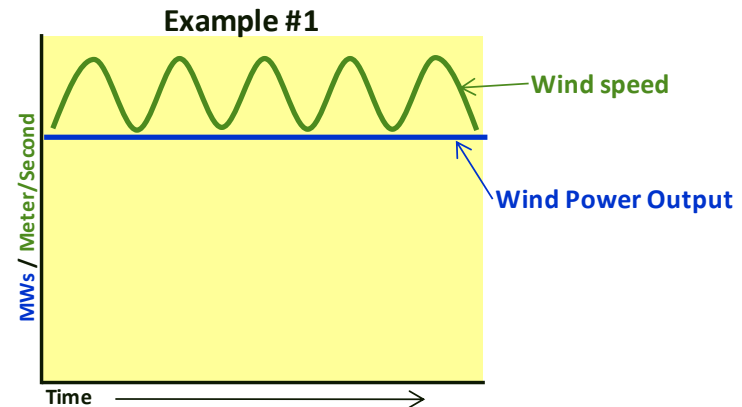
The Challenge of Scheduling Wind Under BPA's Operational Structure

- Weather conditions affecting wind production can change quickly and dramatically
- The current scheduling framework requires an hourly average value (a single number for the hour) but DSO-216 events are measured on a 30 second basis
- Under certain wind conditions, it is possible to incur a schedule curtailment and a generation limit in the same hour with a *perfect* schedule



Impact of Wind Speed Fluctuation

- Wind speed can fluctuate at high speeds without impacting the power output of a wind facility (the wind speed stays high enough even at the lower fluctuation level to maintain full power at a wind generation facility)
- If wind speeds drop – even by a small amount – the impact on power output can be significant
- Wind speeds can change quickly and it is impossible to perfectly predict wind patterns and the corresponding effect on wind power output



Scheduling Practice – An Example

- A 200 MW wind farm has been operating at full power in high, fluctuating wind conditions for 3 consecutive hours
- The fluctuating wind speeds and other meteorological conditions have indicated a down ramp is approaching, but it has yet to materialize
- Given a small drop in wind speed can cause a significant decrease in the wind power output (150 MWs or more), the forecaster recognizes the threat of a DSO-216 event due to insufficient INC reserves and has been scheduling low in anticipation of a steep down ramp
- The forecaster must choose whether to switch to a higher schedule that is not consistent with the best meteorological information in the fourth hour to avoid a PD penalty, or continue scheduling low in anticipation of a down ramp to attempt to protect the system from a DSO-216 event

Between October 2009 and April 2010, when faced with these types of conditions, Iberdrola Renewables scheduled its wind fleet to avoid potential DSO-216 events and incurred numerous PD penalties

April 2010 Meeting Outcome

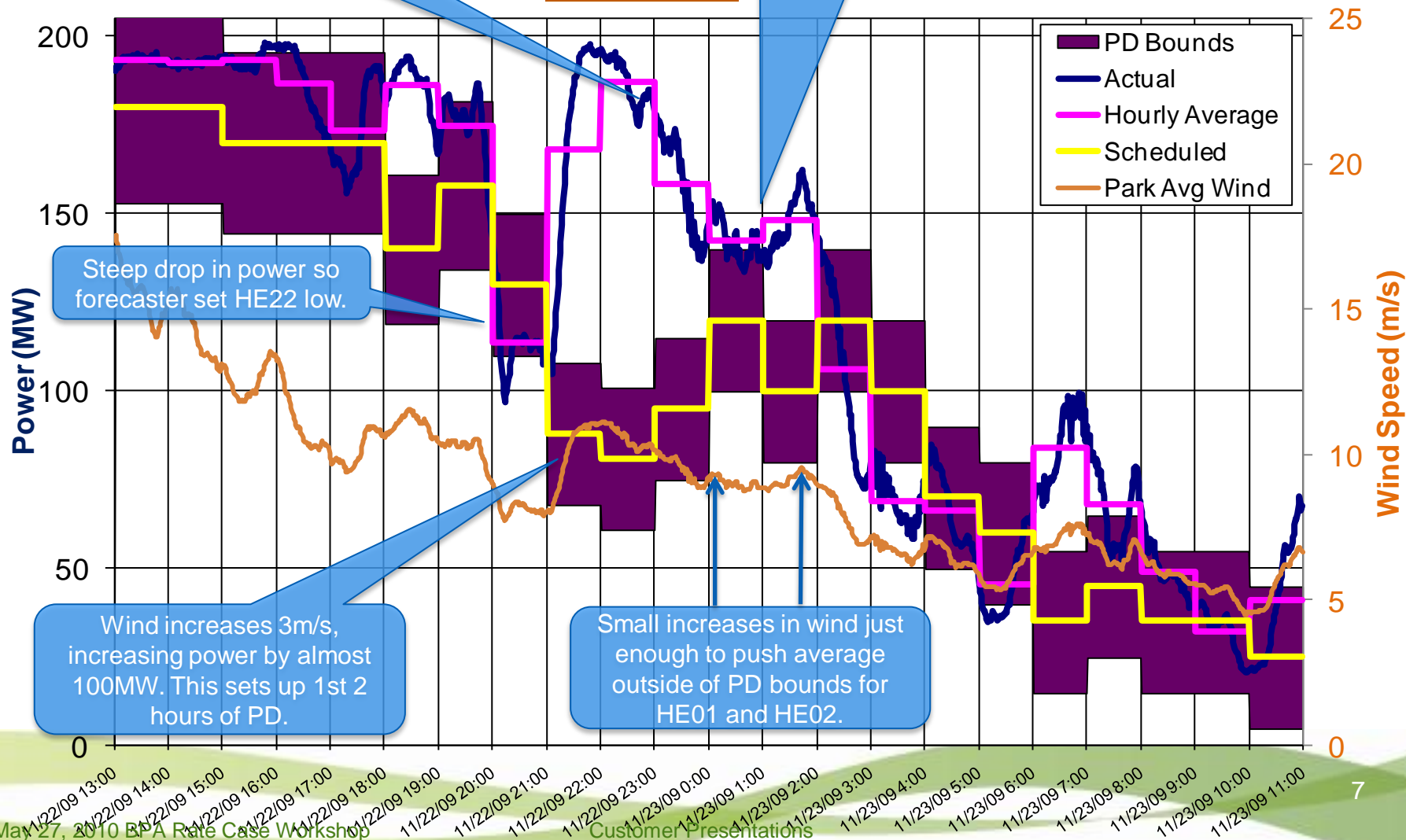
- In April 2010, Iberdrola Renewables met with BPA personnel to discuss its scheduling methodology and resulting PD penalties. Several important messages were communicated to the Iberdrola Renewables team at this time:
 - Scheduling to mitigate DSO-216 events resulted in an accumulation of imbalance energy on BPA's system during periods when wind ramping events took longer to materialize than was forecasted
 - Iberdrola Renewables' decision to bias its schedules in the direction of an anticipated ramp did not avoid DSO-216 events, but reduced the severity of limited / curtailed generation
 - By changing its scheduling behavior to avoid PD penalties, Iberdrola Renewables would be much less accurate in scheduling ramps but the accumulation of imbalance energy is more problematic to BPA's operations and BPA would much prefer Iberdrola Renewables alter its scheduling behavior

Beginning April 19, 2010 Iberdrola Renewables adjusted its scheduling strategy in response to this information from BPA

Forecaster attempts to balance the expected down ramp against 4th hour of PD. Schedule is increased for HE01 despite downward wind trend.

The dance between PD and curtailment risk continues. Schedule increased for HE03 but fortunately not by much. Note 30 minute persistence yields a 50% of nameplate INC

Bighorn



Power lags wind because turbines are yawed eastward. DSO216 limit only marginally avoided

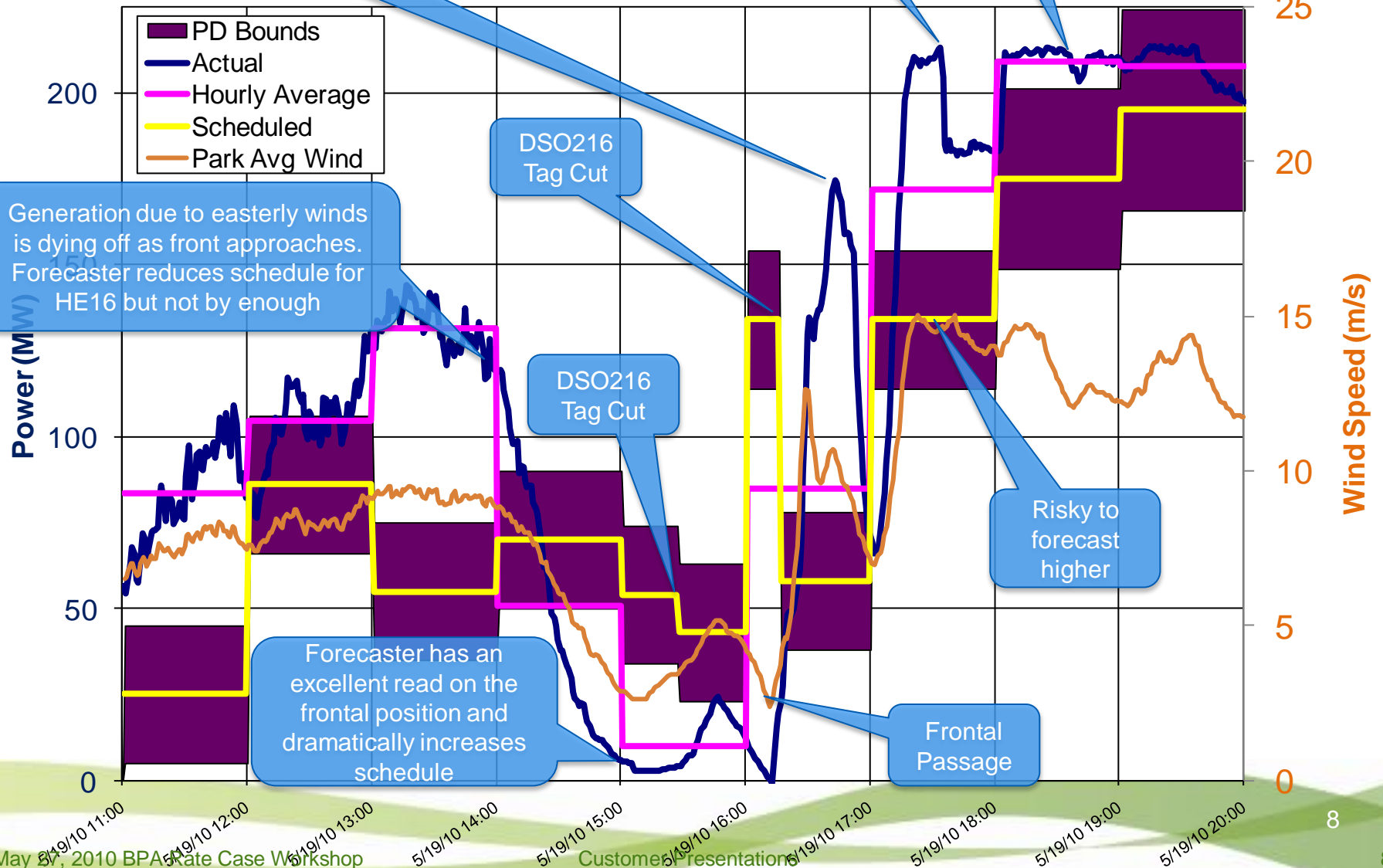
DSO216 Gen Limit

DSO216 Gen Limit
KL3 in band

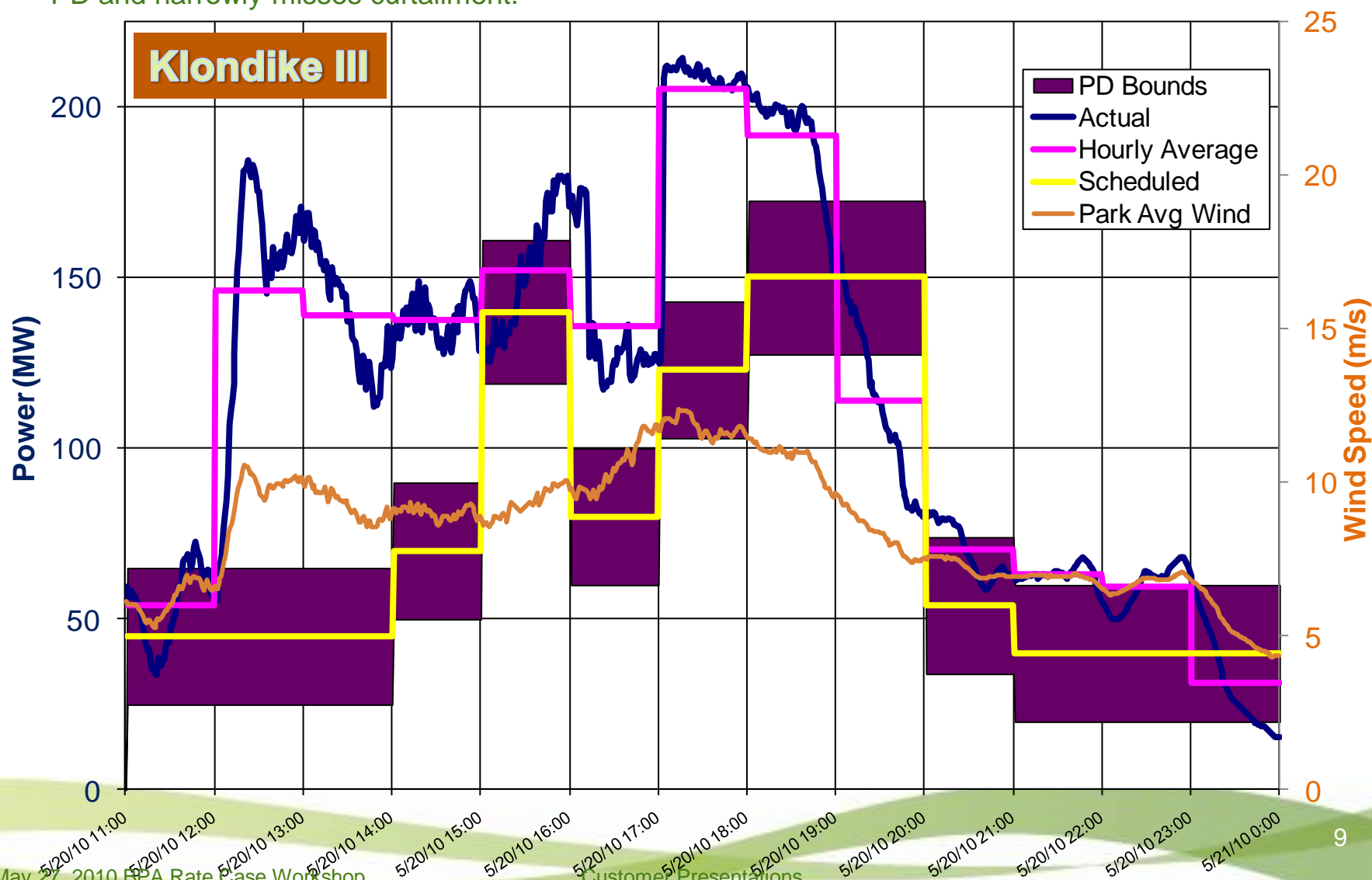


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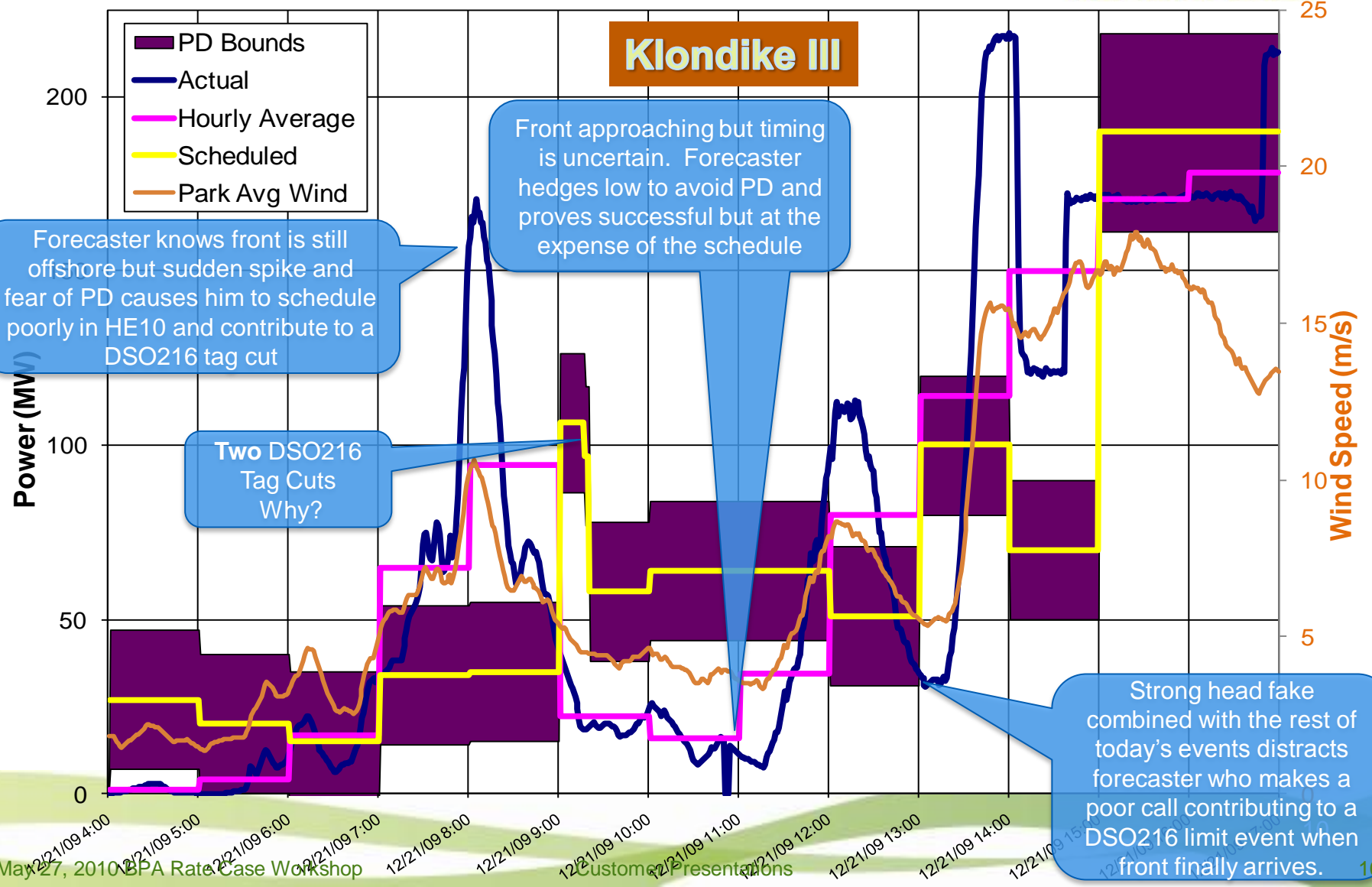
Klondike III



- Unexpected 3-4 m/s wind increase at noon catches forecaster off guard resulting in two hours outside the PD band.
- Lack of large scale support for this event means he is loathe to increase schedules except to avoid PD and contributes to limit in HE17.
- During HE 20 wind collapses but forecaster went as high as he dare to avoid PD and narrowly misses curtailment.



December 21, 2009 Extreme Volatility (Details in UWIG 2010 Forecasting Workshop)





IBERDROLA RENEWABLES

1125 NW Couch Street, Suite 700
Portland, OR 97209
503-796-7063

Justin Sharp, PhD

Director,

Wind Asset Management Meteorology

justin.sharp@iberdrolausa.com

Tel: 503-796-7063

Laura Beane

Market Structure Manager

Regulation and NERC Compliance

laura.beane@iberdrolausa.com

Tel: 503-478-6306

George McLean

Senior Meteorologist

Wind Asset Management Meteorology

george_mclean@iberdrolausa.com

Tel: 503-926-3203

